REMARKS

The present amendment is prepared in accordance with the new revised requirements of 37 C.F.R. § 1.121. A complete listing of all the claims in the application is shown above showing the status of each claim. For current amendments, inserted material is underlined and deleted material has a line therethrough.

Applicants appreciate the thoroughness with which the Examiner has examined the above-identified application. Reconsideration is requested in view of the amendments above and the remarks below.

Claims 10, 13, 14, 18,19, 21, 23, 27 and 28 have been amended.

Claims 10, 13-21 and 23-29 are pending.

No new matter has been added.

35 USC 103 Claim Rejections

Claims 10, 13-21, 23-27 and 29 have been rejected under 35 USC 103(a) as being unpatentable over U.S. Patent No. 5,478,780 to Koerner et al. in view of U.S. Patent No. 5,043,299 to Chang et al. in view of U.S. Patent No. 4,824,309 to Kakehi et al. in view of U.S. Patent No. 4,911,597 to Maydan et al., while claim 28 has been rejected further in view of Japanese Patent Publication No. 63-000480 A to Takebayashi et al.

Applicants' Invention

In the foregoing amendment, applicants have amended the claims to clarify that which is regarded as the invention.

In particular, the claims are directed to apparatus for selectively forming a silicide whereby the apparatus includes a mainframe housing at least an interior cleaning chamber for removing oxide from a surface of a substrate while under a continuous vacuum, and an interior deposition chamber for depositing a metal on the surface of the substrate while under the continuous vacuum. The apparatus further includes at least one workpiece holder within the mainframe for holding the substrate and at least one pump for evacuating the mainframe to maintain the continuous vacuum. The apparatus has at least one input line for providing a chemical agent into the cleaning chamber while under the continuous vacuum, whereby the chemical agent is adapted to remove the oxide from the substrate surface, and an output line for removing the cleaning agent and removed oxide. The deposition chamber within the mainframe has a reactor for depositing metal onto silicon and insulator portions of the substrate surface while under the continuous vacuum. The present apparatus for selectively forming a silicide also includes a heating element for heating the substrate to an elevated temperature to form a silicide over the silicon portion of the substrate surface by reaction with the

metal deposited thereon, while the metal remains unreacted over the insulator portion, as well as an etchant to remove such unreacted metal.

Optionally, the apparatus may include an interior heating chamber within the mainframe for heating the substrate to form the silicide. The mainframe enhousing the cleaning chamber and deposition chamber allows the substrate to be moved from one chamber to another without breaking the continuous vacuum. This interior deposition chamber may be a vapor sputtering device.

In another aspect, the present invention is directed to a system for selectively forming a silicide on a surface of a semiconductor substrate that includes a mainframe having at least an interior cleaning chamber for removing oxide from a surface of a substrate while under a continuous vacuum, and at least an interior deposition chamber for depositing a metal on the surface of the substrate while under the continuous vacuum. The system includes at least one pump adapted to evacuate the mainframe to maintain the continuous vacuum in the mainframe and a chemical agent in the interior cleaning chamber for removing the oxide while under the continuous vacuum. A reactor is within the deposition chamber, which in turn, is within the mainframe, for depositing metal onto the silicon and insulator portions on the substrate surface while under the continuous vacuum. The system may further include a heating element for heating the substrate to an elevated temperature to form a silicide on the substrate surface over the silicon portion by reaction with the metal deposited thereon, while the metal

remains unreacted over the insulator portion, and an etchant to remove such unreacted metal. This heating element may either be external to the mainframe or may be enhoused within the mainframe.

Support for the amendments can be found in the specification on page 6, lines 22-25, page 7, lines 6-15, page 7, lines 19-20, page 8, lines 4-7 and 16-17, page 9, lines 1-10 and in Fig. 1. No new matter has been added.

Koerner et al.

Koerner et al. discloses a system having separate, independent processing chambers connected by intermediate bodies. The system includes high-vacuum chambers of chambers 1-6, a high-vacuum distributor chamber 7 and high-vacuum supply chambers 8, 9 all connected by a central distributor chamber 7. (Fig. 1, col. 4, lines 42-47.) This central distributor chamber 7 is insulated from and independent of chambers 1-6 and the supply chambers 8, 9. (Fig. 1 and col. 4, lines 47-51.) Koerner et al. further discloses uniform formation of silicides across the surface of the substrate by providing a substrate in a chamber 1, which has only an input line of Ar gas and no output line for removing the cleaning agent and the removed oxide. As a result, any removed oxide remains within chamber 1 and therefore may be redeposited thereon the substrate surface.

Chang et al.

Chang et al. also discloses a system having separate, independent processing chambers connected by intermediate bodies. The system of Chang et al. has two separate, distinct processing chambers, i.e., cleaning chamber 10 and CVD chamber 40 that are connected to each other by an air-tight passageway 70. (Fig. 2, col. 2, lines 64-67.) The passageway has a first slit valve 82 that wafer 100 is admitted through to enter the passageway and a second slit valve 84 that the wafer passes through to exit passageway 70 and enter CVD chamber 40. (Fig. 2 and col. 3, line 58-63.) This passageway 70 also has a vacuum pump 90 via pipe 78 for maintaining a pressure in the passageway and an entrance port 74 through which one or more non-oxidizing gases may be flowed into passageway 70 via pipe 76. (Fig. 2 and col. 4, line 1-15.) In accordance with Chang et al. a wafer 100 is cleaned in chamber 10, passes through passageway 70 and then into CVD chamber 40 having a heater 45 to heat the wafer during deposition of tungsten using a mixture of a tungsten-containing gas and a reducing gas flown into chamber 40 via pipe, showerhead 52, 50. (Fig. 2 and col. 5, line 21-30.) An exit port 54 connected to vacuum pump 90 maintains a pressure in CVD chamber 40. (Fig. 2 and col. 5, line 18-20.)

Kakehi et al.

Kakehi et al. discloses a vacuum apparatus comprising a vacuum pre-chamber, a buffer chamber that can be evacuated and a processing chamber in communication with the buffer chamber. (Abstract) In particular, Kakehi et al. teaches that the pre-chamber may be provided in the buffer chamber 10. However, as shown in the perspective structural view of Fig. 3, the buffer chamber 10 is merely in communication with the processing chamber 20, i.e., the buffer chamber 10 does not house the processing chamber 20. (Col. 1, lines 63-64 and col. 2, lines 45-46.) That is, a substrate 30 is carried through the buffer chamber 10 to a position over a substrate electrode 21 in the processing chamber 20, whereby the processing chamber 20 is separated from the buffer chamber 10 via separating means 183. (Col. 5, line 11 to col. 6, line 13.) A process gas is introduced into the processing chamber 20 by adjusting the flow rate, and the vacuum pump (not shown) is actuated to adjust the pressure in the processing chamber 20; i.e., to establish the processing pressure, for etching. (Col. 6, lines 19-34.)

"After the processing is finished in the processing chamber 20, the separation between the buffer chamber 10 and the processing chamber 20 by the separating means 183 is removed; i.e., the processing chamber 20 is communicated again with the buffer chamber 10." (Col. 6, lines 38-42.) The treated substrate is then moved from the processing chamber, into the buffer chamber, into the vacuum pre-chamber 60 and then the treated substrate is recovered from the recovery

cassette 71. (Col. 6, line 43 to col. 7, line 16.) Substrates are treated and removed one at a time in the Kakehi et al. patent. (Col. 7, lines 17-25.) Figs. 3 and 5a-c merely show the units of Figs. 1 and 2 connected in pairs or groups so that "a plurality of vacuum processing units can be connected via an opening provided the buffer chamber." (Col. 7, line 26 to col. 9, line 51, *emphasis added* col. 9, lines 49-51.)

Maydan et al.

Maydan at al. is merely directed to a semiconductor wafer etching system that includes an autoloader mounted within a load lock for providing batch, cassette-to-cassette automatic wafer transfer between the semiconductor processing chamber and cassette load and unload positions within the load lock. (Abstract and col. 1, lines 9-14.) As shown in Fig. 1, the etching system 5 includes a vacuum load lock chamber 7 mounted adjacent a vacuum etching processing chamber 6, both of which are mounted on base compartment 8 (Col. 3, lines 46-58 and col. 6, line 60-65 and col. 7, lines 15-63.)

Takebayashi et al.

Takebayashi et al. is merely cited for the limitation of a heating element external to the chamber. It does not disclose or even suggest an apparatus, as is currently claimed, for selective formation of a silicide on a substrate surface

whereby the apparatus comprises a heating element and a chamber having at least one interior chamber 10 for cleaning the substrate surface by removing oxide therefrom while under a continuous vacuum, and at least one interior chamber 30 for depositing a metal, wherein the wafer is transferred from the cleaning chamber 10 to the deposition chamber 30 within chamber 50 under continuous vacuum throughout the chamber without breaking such vacuum, in addition to, a first line connected to a pump to evacuate and maintain the chamber at a continuous vacuum, a second line for introducing a cleaning agent into the chamber, a third line for removing the cleaning agent and removed oxide, and a reactor –all within the chamber. Accordingly, applicants submit that the Takebayashi et al. does not overcome the deficiencies of the Koerner et al or the Chang et al. references, alone or in any proper combination thereof.

Arguments

The Examiner states that claims 10, 13-21, 23-27 and 29 are obvious over the combination Koerner et al., Chang et al., Kakehi et al., and Maydan et al. Applicants respectfully disagree.

As discussed above, the apparatus and system of the present invention include a mainframe under a continuous vacuum that houses, i.e., encloses, a cleaning chamber for removing oxide from a substrate surface and a deposition chamber for depositing a metal onto such substrate surface, while under the

continuous vacuum. The Examiner has found applicant's arguments with respect to the rejection over Koerner et al. in view of Cheng et al. to be persuasive, and as such, has withdrawn such rejection, however, the Examiner continues to take the position in the above-identified office action that Koerner et al. discloses an apparatus having a plurality of interior chambers (Fig. 1, 1-6; abstract), to which applicants continue to disagree.

As discussed above and previously submitted, both Koerner et al. and Chang et al. are directed to systems that having separate, independent processing chambers that are connected by a central distribution chamber 7 or a passageway 70, respectively. Neither Koerner et al. nor Chang et al., alone or in combination, disclose or suggest an apparatus having a mainframe that houses an interior cleaning chamber and an interior deposition chamber under a continuous vacuum. As such, it is submitted that neither reference, alone or in combination, discloses a first line for evacuating and maintaining a constant vacuum within the mainframe, a second line for introducing a cleaning agent into the cleaning chamber in the mainframe chamber and a third line for removing the cleaning agent and removed oxide from the cleaning chamber to provide a substrate with a substantially oxide-free surface. Accordingly, neither Koerner et al. nor Chang et al., alone or in combination, disclose a mainframe under constant vacuum have therein a cleaning chamber and a deposition chamber for selective formation of a metal silicide on a substrate surface. For these reasons, applicants continue to submit that neither

Koerner et al. nor Chang et al., alone or in combination, render obvious the instant invention as such references do not teach all the structural limitations as instantly claimed. See, Ex parte Masham, 2 U.S. Patent No. Q 2d 1647 (Bd. Pat. App. & Inter. 1987).

However, in the above-identified office action, the Examiner takes the position that Koerner et al. in view of Chang et al. disclose the invention substantially as claimed and described above, however, fail to teach placing the interior processing chambers inside a vacuum chamber. In remedying these deficiencies, the Examiner cites Kakehi et al. stating that it discloses multiple processing chambers located inside a vacuum chamber (Figs. 4a-c; col. 1, row 60-col. 2, row 15 and col. 1, rows 44-50 and col. 8, rows 43-54) for the purpose of assembling a system to cope with change in the process or change in the line.

Applicants respectfully disagree with the Examiner's interpretation of the Kakehi et al. patent. As discussed above, Kakehi et al. discloses a vacuum apparatus comprising a vacuum pre-chamber, a buffer chamber and a processing chamber. As disclosed in Kakehi et al., the pre-chamber may be provided in the buffer chamber, while the buffer chamber 10 is merely in communication with the processing chamber 20, i.e., the buffer chamber 10 does not house the processing chamber 20, whereby such processing chamber 20 is separated from the buffer chamber 10 via separating means 183. (Abstract, Fig. 3, col. 1, lines 63-64, col. 2, lines 45-46 and col. 5, line 11 to col. 6, line 13.)

That is, applicants submit that Kakehi et al. does not disclose a mainframe housing a cleaning chamber and a deposition chamber as is currently recited. To evidence the same, Kakehi et al. further discloses that after a substrate is processed in the processing chamber, separation means 183 between the buffer and processing chambers is removed, "i.e., the processing chamber 20 is communicated again with the buffer chamber 10." (Col. 6, lines 38-42.) Kakehi et al. goes on to merely disclose that a plurality of such vacuum apparatus can be connected to each other. (Col. 6, line 43 to col. 9, line 51.) For these reasons, it is submitted that Kakehi et al. does not remedy the deficiencies of either Koerner et al. or Chang et al., alone or in combination, as such references do not teach all the structural limitations as instantly claimed. See, Ex parte Masham, 2 U.S. Patent No. Q 2d 1647 (Bd. Pat. App. & Inter. 1987).

The Examiner also cites the Maydan et al. patent, however, applicants submit that Maydan at al. does not remedy the deficiencies of either Koerner et al., Chang et al. or Kakehi et al., alone or in any proper combination thereof, as Maydan is merely directed to a semiconductor wafer etching system 5 having a vacuum load lock chamber 7 mounted adjacent to a vacuum etching processing chamber 6, both of which are mounted on base compartment 8 (Col. 3, lines 46-58 and col. 6, line 60-65 and col. 7, lines 15-63.) That is, Maydan et al. does not disclose, suggest or contemplate a mainframe under constant vacuum having a cleaning chamber and a deposition chamber for selective formation of a metal

silicide on a substrate surface as is currently claimed, and as such, does not remedy the deficiencies of Koerner et al., Chang et al. or Kakehi et al., alone or in any proper combination thereof.

With respect to claim 28, the Examiner has further rejected claim 18 in view of Takebayashi et al., however, it is again submitted that such reference is only cited for the limitation of a heating element external to the chamber. The Japanese patent to Takebayashi et al. does not disclose or suggest an apparatus for selective formation of a silicide on a substrate surface comprising a mainframe having enhoused therein a cleaning chamber and a deposition chamber while for formation of such silicide while under constant vacuum as is currently claimed. Accordingly, it is submitted that the Takebayashi et al. Japanese patent does not overcome the deficiencies of Koerner et al., Chang et al., Kakehi et al. or Maydan et al., alone or in any proper combination thereof.

Applicants continue to submit that the instant invention is structurally different from the apparatus and systems disclosed in Koerner et al., Chang et al., Kakehi et al., Maydan et al. and Takebayashi et al., alone or in any combination, such that, the above cited references, alone or in any combination, do not render obvious pending claims 10, 13-21 and 23-29. See, Ex parte Masham, 2 U.S. Patent No. Q 2d 1647 (Bd. Pat. App. & Inter. 1987).

It is respectfully submitted that the application has now been brought into a condition where allowance of the case is proper. Reconsideration and issuance of

a Notice of Allowance are respectfully solicited. Should the Examiner not find the claims to be allowable, Applicants' attorney respectfully requests that the Examiner call the undersigned to clarify any issue and/or to place the case in condition for allowance.

Respectfully submitted,

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